DESIGN AND IMPLEMENTATION OF A CO2 FLOOD UTILIZING ADVANCED RESERVOIR CHARACTERIZATION AND HORIZONTAL INJETION WELLS IN A SHALLOW SHELF CARBONATE APPROACHING WATERFLOOD DEPLETION

Cooperative Agreement Number:	**DE-FC22-94BC14991**
Contractor Name and Address:	**Phillips Petroleum Company** **4001 Penbrook Street** **Odessa, Texas 79762**
Date of Report:	**February 27, 1997**
Award Date:	**June 3, 1994**
Anticipated Completion Date:	**January 2, 2001**
Government Award for 1996 Fiscal Yearr:	**$2,659,515**
Project Director:	**John S. Chimahusky**
DOE Project Officer:	**Jerry F. Casteel**
Reporting Period:	**October 1, 1996 - December 31, 1996**

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OBJECTIVE

The first objective is to utilize reservoir characterization and advanced technologies to optimize the design of a carbon dioxide (CO_2) project for the South Cowden Unit (SCU) located in Ector County, Texas. The SCU is a mature, relatively small, shallow shelf carbonate unit nearing waterflood depletion. The second objective is to demonstrate the performance and economic viability of the project in the field. All work this quarter falls within the demonstration project.

SUMMARY OF TECHNICAL PROGRESS

BUDGET PHASE II

TASK V FIELD DEMONSTRATION

Drill Horizontal Injection Wells 6C-25H and 7C-11H

An initial injection profile survey was run on both horizontal wells during the initial CO_2 injection period. The initial injection profile survey is needed to evaluate injection performance and assess the lateral and vertical distribution of injected fluids. The injection profile on Well 6C-25H indicated fairly uniform distribution of injection fluids under CO_2 injection, confirming the profile logging results obtained under water injection. On the other hand, the injection profile on Well 7C-11H is suspected of having a fracture in the toe region of the well where the majority of the fluid is entering. The capacitance log run indicated a CO_2/water interface in the toe of the well. A fracture had been suspected earlier as a result of the fall off and step-rate testing, but was further indicated by the profile log under CO_2 injection.

The information obtained from the injection profile logs will be used for implementation of mobility control measures, particularly in light of the results of the 7C-11H log.

Drill two vertical WAG injectors along South Cowden Unit boundary - not currently included in DOE Phase II funding

During fourth quarter 1996, three vertical WAG injection wells were drilled along the north boundary with the Emmons Unit. The reservoir in this area is higher on structure than that portion of the reservoir in the vicinity of the above mentioned horizontal WAG injection wells. The advantageous structural position provides additional pay sections. Horizontal wells would not provide for injection into all the productive zones because of permeability barriers between zones. None of the three injection wells were placed on injection during 1996, pending jurisdictional approval for injection.

Drill Two Production Wells

During fourth quarter 1996, two wells were drilled within the project area. The first, Well 7-13, was drilled as a replacement well for production Well 7-06, previously plugged and abandoned. The second, Well 7-15, was drilled as a new take-point on the northern tract line of Tract 7.

	----------AFTER----------			
	BOPD	BWPD	MCFPD	
SCU 7-13	23	87	0	Oct. 21, 1996
SCU 7-15	25	178	2	Oct. 18, 1996

Convert Three wells for Water Injection

During fourth quarter, 1996, three wells were converted to water injection:

	----------BEFORE--------			----------AFTER----------
Well	BOPD	BWPD	MCFD	
SCU 5-02	12	735	3	Shut-in pending injection line tie-in
SCU 5-08	6	60	3	Injecting @ 250 BWPD and 560 psig (Nov., 1996)
SCU 8-18	6	176	1	Injecting @ 518 BWPD and 750 psig (Nov., 1996)

Reactivate Four Shut-in Wells for Production

During fourth quarter 1996, four temporarily abandoned wells were reactivated:

SCU 6-20	11 BOPD	75 BWPD	4 MCFPD	Oct. 19, 1996
SCU 7-02	5 BOPD	119 BWPD	0 MCFPD	Sept 30, 1996
SCU 7-05	5 BOPD	220 BWPD	1 MCFPD	Oct. 8, 1996
SCU 7-10	Shut-in pending flow line tie-in.			

Workover or Recondition Existing Wells

During fourth quarter 1996, five wells were checked for fill and acidized:

	-------BEFORE--------			----------AFTER----------			
	BOPD	BWPD	MCFD	BOPD	BWPD	MCFD	
SCU 2-08	6	90	1	13	128	1	Dec. 12, 1996

SCU 2-21	5	40	1	6	98	3	Nov. 10, 1996
SCU 2-24	7	38	1	9	63	2	Nov. 20, 1996
SCU 6-06	3	40	1	3	148	1	Dec. 12, 1996
SCU 8-02	10	59	1	8	81	0	Dec. 4, 1996

Purchase CO_2 and Operation of Recycle Compression Facilities

No tertiary response is anticipated until mid-1997. However, production is being monitored for CO_2 content in the produced gas stream. CO_2 production commenced during the fall of 1996 in Wells 7-05, 6-22, 6-24 (RC-3), 6-03 and 6-07. The compression/recycle facilities were started-up in December 1996, with the recycle gas being injected primarily in Well 2-26W.

The total volumes injected in all four injection wells for the fourth quarter were:

GAS INJECTION - MCF

	Oct 96	Nov 96	Dec 96
Monthly	242,743	269,465	276,626
Daily Average	7,830	8,982	8,923
Cumulative	576,066	845,531	1,122,157

TASK VI TECHNOLOGY TRANSFER

SPE Paper 37470, "The Evaluation of Two Different Methods of Obtaining Injection Profiles in CO_2 WAG Horizontal Injection Wells," was written by Kimberly B. Dollens, Burl W. Wylie, James C. Shoumaker, Orjan Johannessen, and Phil Rice, for presentation at the 1997 SPE Production Operations Symposium, March 9-11, 1997, in Oklahoma City, Oklahoma. Ms. Dollens will also be presenting this paper at the Phillips Petroleum Company Exploration and Production (E&P) Technical Symposium in Bartlesville, Oklahoma, April 2-4, 1997.

Kimberly B. Dollens presented a talk entitled "Cost Optimization/Operations in WAG Flooding: E. Vacuum Grayburg and So. Cowden Units," and participated in a panel discussion on "Cost Optimization - Installation and Operations, " at the 2nd Annual Permian Basin CO_2 Conference in Midland, Texas, December 10-12, 1996.

Continued development of a South Cowden Unit Internet site for data and technology transfer. Completed the prototype for intra-company use only, but continued editing prior to finalizing for the Internet.

James C. Shoumaker will be presenting a paper entitled "Drilling and Completions Considerations of Horizontal CO_2 Injection Wells - South Cowden Unit," at the Phillips Petroleum Company Exploration and Production (E&P) Technical Symposium in Bartlesville,

Oklahoma, April 2-4, 1997.